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SOME COMMENTS ON STATISTICAL ASPECTS OF

CENTRAL BANK MODEL - 80

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Some Comments on Statistical Aspects of Central Bank Model - 80

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The authors are to be warmly congratulated on the production of this large macroeconometric model. It is good to know that work on it is continuing, so that the following remarks, designed to be constructive, may be found useful. In what follows the Bank document will be termed the "report".

Description

There are 266 endos and equations in the model, many nonlinear, and 130 exos. Of the 266 equations 100* are behavioural and 166 identities. Period of estimation is the 18 years 1960-1977, time unit being the year. The behavioural system is dynamic, i.e., some equations containing on r.h.s. endos lagged one year. Method of solution is, for the most part, single equation ordinary least squares (SEOLS). 2SLS was resorted to for the wage-price sectors but it is stated that there was little difference between SEOLS and 2SLS in coefficient estimates of these equations. There is a description and commentary on each of the equations, giving the usual statistical test functions, $\bar{R}^2$, D.W., coefficient estimates with t-values, etc. for each of the behavioural equations. Much of the commentary in the report bears on the plausibility of the values and signs of the coefficients of the latter.

There are many diagrams comparing graphs for actual and estimated (miscalled "predicted", as is usual). The numerical effect is shown of unit increases in certain policy instruments (mainly public authority taxes and expenditure), for six years starting with base year 0, for 36 most important endos.

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*Only 75 are listed in Appendix 1 of the report as having coefficients C to be estimated, all 75 estimated in Section 3.

It is stated that, as far as possible, national accounting definitions and values are used; also that there is now available an annual time-series data bank containing over 1,000 time-series, including almost all national account items.

In the equation system there are 7 sectors and 25 sub-sectors, as follows:-

Equation System

Sector	Sub-sector	No. eqs.
A Demand:	consumption, investment, stocks, GNP	40
B Trade:	exports, imports, EEC transactions, balance of payments	29
C Output:		9
D Labour market:	wages and other incomes, productivity and wage costs, employment and unemployment, labour supply	32
E Government:	current expenditure, capital transactions, excise taxes, expenditure taxes - VAT, expenditure taxes - other, direct taxation, borrowing	80
F Prices:	consumer, output, government, investment, stocks trade	69
G Monetary:		7
	Total number of equations	266

The considerable emphasis on the Government sector and on prices will be noted.

Commentary on method

The modelmakers make no extravagant claims for their results. Indeed, there is a tendency to play these down. I have no objection to the use of OLS. I know it is regarded as controversial but I claim that the object of this exercise is not individual coefficient estimation but the estimation of

the endos, given the values of predetermined variables, exos and lagged endos. The individual equations are the more useful for their being estimated separately. Some of the equations are, in fact, very interesting. Equation 80, for instance, seems to re-establish Phillips, fallen into disrepute in Ireland in recent years.

The following comment is subject to the important qualification that the behavioural equations and the r.h.s. variables included in these seem to be the resultant of much experimentation involving rejection of poor equations and coefficients. Such selection would mean that formal tests of NHP significance would not strictly apply. However, we do not wish to exaggerate this objection. Sufficient to state that, as a whole, the equations are excellent in closely representing the data during the sample period. When significance is referred to in what follows formal significance at .05 (and usually very much below this) NHP is meant. Reference is to behavioural equations only.

All equations are significant by the F test, most overwhelmingly so. This is a more meritorious showing than might appear at first sight (time series all going up, a period of acute inflation being the sample period) since most of the non-price endos are at constant prices and the price endos are usually in delta, or delta percentage, form, i.e., denoted by "DOT" as final letters (e.g., PMPTDOT = Percentage change in deflator of total import). (Should not "percentage" usually be "per unit", e.g., PMTDOT is given as Del(PMT)/PMT(-1)? Presumably "Del" is Delta and not 100 x Delta).

Of the 75 equations only 15 have an $\bar{R}^2$ less than .9. Even using raw data (instead of delta percentage) with time series OLS a high $\bar{R}^2$ may be regarded as significant when accompanied by an acceptable DW. If we regard a DW of 1.6 as "acceptable" (i.e., as not negativing an hypothesis of residual independence, or completeness of relationship), the number of equations with

DW <1.6 was 20.

The total number of coefficients (other than the intercept) estimated in the 75 equations was 184 and of these only 29 had t values less than 2.

Dynamism enters through the lagged endos on the r.h.s. There are 17 such (lagged one year) amongst the 75 equations. There are also some lagged endos amongst the identities.

By the statistical standards of these exercises the present model passes with honours. However, our consideration of the model cannot stop here.

Basic assumptions

The behavioural equation system is to a certain extent rooted in economic theory, supply-demand, consumption function etc. This does not necessarily make them statistically acceptable. There are a few references to equations being those of other researchers; in so far as the present investigation confirms the work of others the results are reassuring.

Equation systems are designed to describe the working of the economy. Even a large model like the present cannot hope to do this. The inevitable presence of disturbances proves this. It is fortunate that for planning absolute exactitude is not required.

Each structural equation is a causal statement. Almost invariably a single current endo appears on the l.h.s. The OLS equation is a statement that the r.h.p. variables (exos and endos current and lagged) are the cause of (or "explain") the l.h.s. variable. This is plausible when the r.h.s. variables are lagged and when the exos are genuine, but not generally.

Associative relationship

With only two stochastic variables X and Y the reason there are two distinct OLS regression relations is that each enshrines a different causal theory, one that X is the cause of Y, the other vice versa. This statement

can be generalised to apply to many variables and many equations. Reiersol, Geary and a very few others years ago tried to establish linear relations between stochastic variables not involving cause-effect but termed associative. In the case of two variables the associative relation in general would lie between the two OLS regression lines. In another form of words the relationship sought might be described as functional as distinct from regressional. If such relations could be obtained, they would be more analogous to the identities, so much more numerous in Model-80 than the behavioural set.

It is extremely hard to envisage truly exogenous internal variables except time itself and the weather, say. Prices of imports and exports can be assumed by a small country to be exogenous,but not volumes.

In the simplest form of consumption function X is income and Y consumption. When one writes

$$Y = a + bX + u$$

and estimates the coefficients a and b by OLS regression, one implies that income precedes consumption in time, which, in general, may be assumed to be very short (say a week or a month) in relation to the time unit of the experiment, say a year. However, in a table of annual statistics X and Y will appear as simultaneous. But consumption creates income, consumption now preceding income in time, again presumed short. The table of annual time series of income and consumption tells two stories, making a strong case for regarding a single relation as associative. Of course these relationships could be separated out even using OLS expressing Y in terms of lagged Xs and vice versa, the lag time being very short. The trouble here is that one has few statistics for very short time intervals so we must make do with what we have, mainly annual time series.

The point here is that with a table of several annual time series one may not be warranted in assuming that a particular variable is caused by

a set of other variables, with or without lagged terms. Satisfaction of all the usual statistical tests may not validate one's assumed causal relationship.

It is true that the supply-demand approach in equation formation imparts some reality to cause-effect in economics. (We remark, en passant, that in the vast literature of applied statistics there are thousands of statistically satisfactory single demand equations and few supply equations, and these invariably less valid than demand equations.) But demand-supply deal only with price and quantity. Price is the l.h.s (i.e., effect) variable in the demand equation, quantity in the supply. Each equation contains current price and quantity, the equations being made identifiable by tucking different indvars or lagged depvars on right hand sides.

There are many more variables in any comprehensive/equation system than prices and quantities and it is impossible to cope with all of these systematically on supply-demand lines. The answer might be associative relationship, tending to eliminate the distinction between endo and exo. The present writer, however, will be the last to deny the statistical difficulty of this approach and is well content to make the best use we can of existing systems, however derived.

It is suggested that the Research Department of the Bank take up this problem of associative relationship as applied to economic time series. Reiersol and Geary almost simultaneously involved a theory of estimation and Geary had a large sample formulation of standard deviations. He had the impression that sampling errors of estimation of coefficients were very large, much larger than with OLS, that validation of one's hypothesis of associative relationship required the satisfaction of stringent conditions and that the theory was impractical because of the magnitude of the calculations. The latter difficulty may no longer be true, with the advent of the computer.

The uses of Model-80

In Section 5 of the report no very large claims are made for inferences to be drawn from the model, to the point of one's inquiring whether most of these could have been derived by rudimentary analysis. Though most of the behavioural equations are satisfactory by statistical tests and visually by the diagrams in Sections 3 and 4 the fact remains that the standard error of the regression within the sample period (SER in the paper) often seems to be of the order of the year-to-year change. This would disqualify some of the equations for short-term forecasting, i.e., estimating beyond the sample period, for the extrapolation errors are even larger than the within-sample errors. Even so, one would have liked to have forecasts of the main endos for the years 1978 to 1985. Actual data for 1978 and 1979 are reasonably firm by now and could be compared with the Model-80 estimates. Would the model forecast the present recession?

Exogenous variables

The 130 exos may be classified as follows:

Pertaining to -	No. of exos
1. Agriculture	7
2. Foreign	23
3. Banking, finance	8
4. Public authority, ex taxation	35
5. Taxation, subsidies	46
6. Population	4
7. Other	7
Total	130

These are not exclusive categories; in particular, allocation between heads 3-5 is somewhat arbitrary. Head 4 is mainly of total amounts in £ million, head 5 of rates, indexes etc. In 5 also there is a curious multiplicity of personal tax bands: 9 of the 46 exos have this character and rate of personal

tax on "tranches of income" (undefined) account for another 9. The reason for the concentration on government variables is that it is through these that the economy can mainly be influenced; they are the policy instruments.

Model-80 is a development from model MINI. One direction has been the transfer of variables from the exo to the endo category, clearly an improvement. Obviously in the next version most of the internal agricultural items must become endos. There is no specific mention of Irish agriculture (except as "non") in the list of endos though it contributes to many of these, GNP consumption, exports, etc. An Irish model without agriculture and its divisions as endos is Hamlet without the prince.

There are many Government variables amongst the endos so that much thought must have been devoted to their segregation into exos and endos, i.e., the variables regarded as causes and effects. The question arises as to whether <u>any</u> Government variables can be regarded as exos and usable for directing the economy. I think that, to a large extent, they can be regarded as under Government control. While direct taxation is an endo, depending on income, and indirect taxation depends on consumption, the large recourse to loans, home and foreign, no longer constrains Government to live within its means. Loans give Government much freedom of action and, even without loans, there are immense possibilities for varying the incidence of taxation, to serve political and economic ends. One has the impression that much more could be done in the way of this variation. Why should there be always a tendency to distribute burdens and benefits equally? Why not tackle unemployment seriously in one budget, education the next, etc. More or less equal distribution with something for everyone results in not enough to have an appreciable effect in any sector. There may be a case for all for one and sacrifice by others.

Loans are not boundless. The general impression is that Ireland has been a prodigal spendthrift but clearly the end is not yet (as a value judgment

one might add the word "unfortunately"). One notes that employment in public administration, included in head 6, is an exo, obviously a very important one.

Basic data

Almost as welcome as the fact of Model-80 itself is the news of the data bank of more than 1,000 items, presumably of annual data starting with 1960. After personal experience of its kindness it is assumed that the Research Department of the Bank would make this data, or parts of it as required, available to other researchers. One notes that many memoranda are available explaining methods of estimation where this was necessary. In some cases these must have been heroic but the Bank researchers can validly argue for the reasonable accuracy of estimation that those used in Model-80 behaved well, on the whole, i.e., were highly correlated with other data they should be related to. As an example, one may inquire if endo net output of industry at constant prices (QI) was calculated using double deflation ?

Presuming prompt availability from store at low (or no) cost, it may not seem necessary to publish all this data. It is suggested, however, that a full descriptive list be published. It is assumed that the series will be systematically kept up to date.

Would the Research Department also prepare as many series as possible for shorter periods than a year, quarterly, monthly, even weekly? Or take the initiative, in co-operation with CSO and other organisations. I have been a severe critic in the past about the statistical quality of the quarterly national accounts of certain other countries but now I eat my words to state that Ireland can no longer do without them! The trouble about seeking relationships between annual series is that in most cases these are concealed as smoothed away by annual summation, as already indicated. Economic reaction occurs invariably in periods of less than a year.

Ready availability of data will act as a stimulus to research. A very large part of the task of researchers is the setting up of tables of data. The kind of data we all want is to a large extent the same. The prospect of having to prepare our basic statistics as well as analysing them, is a deterrent to tackling a problem.

I am well aware that the delay in the production of many current statistics is not the fault of CSO but of their sources of supply. But this delay, whatever the cause, is a major national, and not merely a statistical, problem. Could the Central Bank take the initiative in improving this situation, in co-operation, of course, with CSO? The CII/ESRI inquiries are useful, but something more in the way of the actual statistics of the CSO type, might be promptly obtainable from small, selective samples, bell wethers in fact.

Behaviour of Model-80

Section 6 of the report, providing 21 tables of the separate effect of unit increases in 21 exos on 36 selected endos in base year (0) and five subsequent years. Units are usually £1m. but sometimes in rates, e.g., one per cent. Presumably the effect on the endos of several policy instruments simultaneously will be found approximately by addition and that negative unitary changes will be close to the negatives of the figures in the tables. The changes over the six years are different because Model-80 is dynamic; it is also non-linear.

Sometimes the per unit change effect actually relates to an endo, an exo closely related to the endo being used as the policy instrument, the exo being given the change value corresponding to the unit change in the endo.

In Section 6 the effect of each of the unitary changes in the exos is discussed in considerable detail. Table 1 has been prepared from the 21 tables of Section 6 to obtain a global view, with particular attention to consistency. Data has been reduced to 14 exos, 17 endos and two years, the base year (0)

and the 5th year (5). Figures given in the report to four decimals are here reduced to two.

In the following comment we concern ourselves with individual endos, with global comparisons between the endos, particularly between closely related endos, and scarcely at all with exo-endo relationship, dealt with at length in the report.

[Table 1]

[Key to notation of Table 1]

Most interest will centre on the model's employment showing, i.e., on how Government policy, exercised by unitary changes mainly in the fiscal instruments will affect non-agricultural employment (EMP), the labour force (L), net emigration (N) and unemployment (U). In Table 1 these are all expressed as decimals of one thousand. In Table 2 they are given in units.

[Table 2]

Considering that the effect involved is a change of £1m. in Table 2 the employment effect is generally small, best in public authority physical non-residential building capital formation (GKIOB). An effect of, say, 100 employed as a result of £1,000,000 expenditure equals a cost of £10,000 per job which seems very high. IDA's figures for industry at current cost are of the order, per job, of £5,000 Irish Government contribution in a total capital cost of about £25,000. The showing of Table 2 is generally consistent, increases in employment and the labour force being accompanied by declines in unemployment and net emigration. A curious result not shown in Table 2 but evident from Table 1 is that an increase of 1,000 in Government employment (EPA) will have the following effects:-

	EMP	L	N	U
0	300	140	-100	-160
5	150	200	-30	50

Table I. Effect on certain endos of unit positive increases in certain exos, in base year (0) and after five years (5), with unit stimulus applied in years 0-5 inclusive.

EXO (x is per £ /m)		AAE xI00	BP	C	EMP	GBR	GCG	INB	IOB	L	N	PC xI00	PRO	QPRI xI00	U	WS	XI	Y
I		2	3	4	5	6	7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8
		£000	£m	£m	000	£m	£m	£m	£m	000	000	(75 as I)	£m	pp	000	£m	£m	£m
GCGO[x]																		
	0	0.02	-I.06	0.79	0.05	-0.89	I.00	0.I0	0.I3	0.02	-0.02	-0.00	I.48	0.02	-0.03	0.32	0.II	I.62
	5	0.04	-0.59	0.50	0.06	-0.79	I.00	0.02	0.04	0.06	-0.02	0.00	I.I2	-0.00	0.00	0.52	0.I0	I.23
EPA																		
	0	0.05	-I.29	I.09	0.30	-0.2I	I.00	0.I2	0.I5	0.I4	-0.I4	-0.00	0.36	0.03	-0.I6	I.47	0.I4	I.87
	5	0.I6	-0.7I	0.67	0.I5	-0.46	I.00	0.02	0.06	0.20	-0.03	-0.0I	-0.I3	0.I8	0.05	I.9I	0.I7	I.37
GCSO[x]																		
	0	0.0I	-0.56	0.60	0.03	-0.74	0.00	0.04	0.05	0.0I	-0.0I	-0.00	I.26	0.0I	-0.0I	0.I6	0.04	0.48
	5	0.02	-0.3I	0.37	0.03	-0.57	0.00	0.0I	0.0I	0.03	-0.0I	0.00	I.0I	-0.0I	0.00	0.25	0.0I	0.25
RSUCG																		
	0	-0.05	-I.54	I.63	0.I0	-0.3I	0.00	0.09	0.II	0.05	-0.04	-0.04	0.72	0.00	-0.05	-0.05	0.I9	I.33
	5	-0.0I	-0.76	0.8I	0.I4	-0.47	0.00	0.02	0.02	0.I3	-0.04	-0.03	-0.04	-0.I0	-0.00	0.00	0.4I	0.52
RUB																		
	0	0.0I	-0.78	0.84	0.04	-0.64	0.00	0.05	0.07	0.02	-0.0I	-0.00	0.37	0.0I	-0.02	0.22	0.06	0.68
	5	0.03	-0.69	0.82	0.07	-0.63	0.00	0.02	0.03	0.06	-0.02	0.00	0.04	-0.02	-0.0I	0.52	0.02	0.55
GKINB[x]																		
	0	0.0I	-I.23	0.34	0.05	-0.79	0.00	0.77	0.08	0.02	-0.02	0.00	0.44	-0.0I	-0.03	0.27	0.04	0.57
	5	0.04	-0.89	0.I7	0.08	-0.78	0.00	0.62	0.02	0.08	-0.02	0.0I	-0.04	-0.08	-0.0I	0.63	-0.I0	0.I7
GKIOB[x]																		
	0	0.0I	-I.07	0.57	0.I4	-0.59	0.00	0.09	0.83	0.06	-0.04	0.00	0.58	-0.04	-0.07	0.60	0.0I	I.00
	5	0.07	-0.72	0.33	0.I0	-0.62	0.00	0.02	0.75	0.II	-0.03	0.0I	0.II	-0.02	0.0I	0.96	-0.05	0.63
GKLO[x]																		
	0	-0.00	-0.26	0.00	0.00	-I.00	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00
	5	0.00	0.09	0.00	-0.00	-I.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.00	0.00	0.00
GTERATFC[x]																		
	0	-0.00	0.55	-0.60	-0.03	0.74	0.00	-0.04	-0.05	-0.0I	0.0I	0.00	-I.27	-0.00	0.0I	-0.I6	-0.04	-0.48
	5	-0.02	0.3I	-0.37	-0.03	0.57	0.00	-0.0I	-0.0I	-0.03	0.0I	0.00	-I.00	0.00	-0.00	-0.25	-0.0I	-0.25
RAL																		
	0	0.08	2.43	-2.57	-0.I5	0.27	0.00	-0.I5	-0.I8	-0.07	0.07	0.08	-0.80	0.00	0.08	0.I4	-0.3I	-2.09
	5	0.02	I.I2	-I.26	-0.22	0.63	0.00	-0.03	-0.03	-0.22	0.07	0.06	0.37	0.I7	0.00	-0.60	0.II	-0.8I
RIOIL																		
	0	0.05	I.74	-I.84	-0.II	0.48	0.00	-0.II	-0.I5	-0.05	0.05	0.05	-I.02	-0.00	0.06	0.02	-0.2I	-I.50
	5	0.0I	0.89	-0.95	-0.I5	0.64	0.00	-0.02	-0.03	-0.I5	0.05	0.03	-0.I9	0.II	0.00	-0.49	0.07	-0.6I
RSIPR																		
	0	-0.0I	0.64	-0.70	-0.03	0.55	0.00	-0.05	-0.05	-0.0I	0.0I	0.00	-0.3I	-0.0I	0.02	-0.I9	-0.05	-0.56
	5	-0.03	0.5I	-0.62	-0.05	0.47	0.00	-0.0I	-0.02	-0.05	0.02	-0.00	-0.0I	0.0I	0.00	-0.4I	-0.0I	-0.4I
RTPYMAL																		
	0	-0.0I	0.8I	-0.86	-0.04	0.66	0.00	-0.06	-0.07	-0.02	0.0I	0.00	-0.38	-0.0I	0.02	-0.23	-0.06	-0.70
	5	-0.03	0.64	-0.77	-0.77	-0.06	0.59	0.00	-0.02	-0.06	0.02	-0.00	-0.02	0.02	0.00	-0.5I	-0.0I	-0.5I
RVI																		
	0	0.08	2.29	-2.42	-0.I4	0.34	0.00	-0.I4	-0.I6	-0.07	0.06	0.07	-0.88	0.00	0.08	0.II	-0.29	-I.98
	5	0.00	I.23	-I.32	-0.2I	-0.2I	0.96	0.03	-0.04	-0.2I	0.07	0.05	-0.44	0.I4	0.00	-0.7I	0.09	-0.85

Note

See accompanying key to notation used. Units of endos are shown at column heads, Units of positive increase in exos are as indicated in key. Borrowing by public authorities (GBR) is actually income minus expenditure and in ordinary parlance the actual figures are the negatives of those shown in the column, as taken from the report. Balance of payments (BP) is exports minus imports.

Key of notation of Table 1

Values are in £million unless otherwise described; at constant prices unless indicated as current (C). P.A. = public authority.

Exogenous

GCGO: P.A. expenditure on goods and services

EPA: P.A. employment (000).

GCSO: P.A. subsidies (non-consumer).

RSUCG: consumer subsidies per constant £ consumption of non-durable goods.

RUB: average rate of weekly unemployment benefit (£).

GKINB: P.A. physical capital formation, non-building, C.

GKIOB: P.A. physical capital formation, non-residential building, C.

GKLO: P.A. loans, purchases share capital, other, C.

GTERATFC: P.A. revenue from rates other than on private dwellings, C.

RAL: index of tax rate on alcohol, 1975 as 1.0.

RLOIL: index of tax rate on petrol (light oil), 1975 as 1.0.

RSIPR: rate of pay-related social insurance contributions, employer and employee (per cent or per unit?)

RTPYMAL: tax allowance for a married woman, £.

RVI: VAT rate on non-durable goods and services, except food.

Endogenous

AAE: average annual earnings non-agricultural

BP: balance of payments (exports-imports)

C: personal consumption

EMP: non-agricultural employment

GBR: P.A. borrowing, C.

GCG: P.A. net expenditure on goods and services.

INB: G.D.F.C.F., non-building

IOB: G.D.F.C.F., non-private building

L: Labour force

N: net emigration

PC: personal consumption price.

PRO: non-agricultural profit, C.

QPRI: index of labour productivity in industry.

U: Unemployment.

WS: non-agricultural wages and salaries, C.

XI: exports of manufactured goods

Y: GNP

Table 2: Change in number consequent on £1m. increase in six policy instruments in Table 1 in which unit is £m.

Exo	EMP	L	N	U
GCGO				
0	50	20	-20	-30
5	60	60	-20	0
GCSO				
0	30	10	-10	-10
5	30	30	-10	0
GKINB				
0	50	20	-20	-30
5	80	80	-20	-10
GKIOB				
0	140	60	-40	-70
5	100	110	-30	10
GKLO				
0	0	0	-0	-0
5	-0	-0	0	0
GTERATFC				
0	-30	-10	10	10
5	-30	-30	10	-0

Note

Zeros in unit place are results of rounding in Table 1. Figures to unit place would be derivable from the report.

It is hard to understand why the base year (0) effect on non-agricultural employment (EMP) should be as low as 300. Has Government employment resulted in a reduction of 700 in non-agricultural employment other than public authority?

May Costa-Dempsey-Geary (see ESRI Broadsheet No. 14) regard the employment figures of Table 1 as a confirmation of their thesis that to solve the endemic Irish unemployment problem the unemployed must be set directly to work ? Economic measures alone will not solve the problem.

It is recommended that the Research Department in its future work devotes its closest attention to employment aspects of the model.

Table 1 merits more attention than it is possible to give it in this memorandum. Generally the financial effects, in contrast with employment, are very large but very variable.

Noting that average annual earnings in non-agriculture (AAE) are 1/100 of those shown in column 2 of Table 1, the wage effect of the various policy measures would be negligible. This showing seems in conflict with some of the substantial amounts non-agricultural wages and salaries (WS) in column 16, especially having regard to the small labour force (L) etc. effect.

With balance of payments (BP) as a consideration, column 3 shows that the policies of the top half (with imports exceeding exports) lack merit. Increased consumption (C) implies worsening of the trade balance, and vice versa. Almost the same remark applies to the current Government borrowing requirement (GBR),column 6, and to Y (GNP at constant prices, column 18). Government net expenditure on goods and services at constant prices (GCG, column 7) is almost non-existent, except where automatically so. INB (column 8) by definition is necessarily less than IOB (column 9); why this is not the case with exo GKINB is not clear. Noting that personal consumption price (PC,

column 12, a unitary index) is multiplied by 100, policy changes would have hardly any effect, as would be the case with labour productivity in industry (QPRI, column 14). (It is hard to determine what the base is in this case, so that the unitary change may indeed be too small to show significance.)

Non-agricultural profit (PRO) and wages and salaries (WS), columns 13 and 16, may be considered together. Different policies would result in enormous differences favouring one side or the other. Once more, profits and wages are generally positive for policies in the top half of Table 1, negative in the lower half; and in the profitable half profits usually exceed wages. Invariably between year 0 and year 5 the trend is inverse with profits and wages as one would expect.

The effect of the policy measures specified on manufactured exports (XI, column 17) would be slight, except in the direction of decline.

One is left strongly with the impression that none of the single policy actions in Government control seem likely to result in entirely favourable results.

Most of the figures for year 5 seem to be lower in absolute value than for base year (0) which seems to be what is meant by tending in the direction of equilibrium. This invites the comment that no special merit resides in equilibrium as an apparent objective.

Conclusion

- The advent of Model-80 is most heartily to be commended.
- Genuine forecasts of endos, i.e., extrapolations beyond the estimation period should be produced, perhaps for each year 1978-1985.
- Forecasts should be compared with results obtained by simpler, including naive methods. Some experts hold that more accurate macro estimates can be obtained from small than from large equation systems. Would the Research Department experiment with systems with fewer equations (say less

than 10 behavioral), for comparison of results from Model-80?

- Experiments in policy formulation should be greatly extended with the ultimate object of finding an optimal set of policies. Or something like the postwar Dutch system might be tried out. In principle Model-80, with its largely OLS system of estimate, is not very different from that of Jan Tinbergen, the pioneer in this field. The Dutch practice was to present the Government with the results on the macros of several policy sets. The extent to which these were utilised in policy determination is not known, or whether they are still used. It should be quite easy to show the results of simultaneous change of several policy variables for different amounts of each variable, for the information of the public as well as the Government.

- To realise the objectives of the foregoing paragraph the exos should include more policy instruments, in the general direction of improvement in regard to unemployment, national debt, inflation, the rate of interest, etc. The endos may also require extension. As it stands the report gives but little indication of how it might help in these directions.

- The Research Department might extend its investigations towards associative, as distinct from cause-effect, relations implied in OLS.

- Could not inquiries be extended to micro-economic relationships, e.g., a particular industry, a particular area, etc. after special ascertainment of basic data? Macro laws may emerge from micro inquiry.

- The Research Department should issue a memorandum listing and describing the great bank of data of time series it has prepared and stating the conditions under which all or any of the series could be made available to other researchers. The Department should make itself responsible for keeping existing series up-to-date. In co-operation with CSO, Department of Finance, etc., it should make itself responsible for the preparation of banks of time series for periods of less than a year, i.e., quarterly, monthly, etc.

and ultimately models based thereon. It would be a great step forward if there could be available somewhere great banks of time series, available to researchers with the least delay.

- The Bank and CSO should involve themselves in the major task of improving the time schedule of existing current statistics, delays being a major deterrent to reliable short-term forecasting.

- One would like to have a discussion of the problem of whether valid relations between policy variables deemed to have acted more or less autonomously in the past can be expected to operate instrumentally in future.

- Even if behavioural equations cannot be derived from past data, they could be invented if few in number with reasonable coefficients, as needed for the extension of Model - 80 into policy formulation.

- The effect of nonlinearity of Model - 80 should be investigated by comparing single exo changes of say $\pm 1/2, \pm 1$ and ± 2 on the endos on Section 6 lines; also how the effect on endos of simultaneous sets of changes compares with the sum of single changes: smallness of differences would facilitate policy experimentation.

- There are a few suggestions in the text of this memorandum not reproduced in this conclusion.

The most important recommendation is that Model - 80 should be used to show the probable economic and social effects of different policy sets, thus helping the people to make a choice.

The present unfortunate commitment of the UK government too largely to a single policy line is an example which Model - 80 might enable this country to avoid.

11 November 1980

R.C. Geary.